Threat and protection for personnel and equipment in Out of Area operations

Research and support in The Netherlands

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Introduction

For the MOD's in Europe the participation in UN and NATO- Out of Area Operations has become a totally new mission in the last five years. The consequences for the organization are enormous. Instead of operating in a static, well known and prepared infrastructure, the missions must be organized and fulfilled in a mobile infrastructure. In the peace-keeping and peace-enforcing mission the priorities are set different from war time. Safety of own personnel is paramount, while equipment is of minor importance. This new situation leads to new demands and requires new solutions.

Thinking about the tasks of the Corps of Engineers (CoE), new experience has to be built up about aspects like the threat level, the demanded level of protection, munition storage, hastily constructed protective structures, available materials, logistics and standardization.
TNO-PML is one of the laboratories for the technical and scientific support of the Dutch MOD. In this paper we want to indicate our experience and ideas on the support and research dedicated to the tasks of the Corps of Engineers (CoE).

2 The new situation and the consequences

The task of the military engineers in peace-keeping and peace-enforcing operations is broad and the conditions and circumstances are scarcely known in advance. In order to fulfill their task on mobility (e.g. roads and bridges), structural protection (for personnel, equipment and munition) and the supply of water, electricity and fuels, the military engineer must be well equipped with knowledge, expertise and materials. But what he needs depends on his specific task but also on the geotechnical and climatologic conditions and the existing infrastructure.

The keywords appear to be communication, collaboration and flexibility combined with inventiveness. Answers and solutions must be found for unforeseen problems. Knowledge,

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expertise and materials that is not at hand must become available. Therefore, communication and collaboration are essential while standardization is needed.

What is the status in 1996 for the Dutch Corps of Engineers?

Communication

A Central Information Point of the CoE (CIPG) has been realized in the Netherlands. A network of internal and external experts was organized and data bases can be consulted. In this way a back-up system has been realized for the engineer in the field. If he needs information he contacts the CIPG with an on-line connection, and he gets his answer as soon as possible. Essential in this communication system are the right disciplines and expertise's in the network, the accessibility and of course the skills of the engineer to formulate his question uniquely. A constant feed back of information and experiences is needed and the system improves continuously. Figure 1 gives the organisation scheme of the CIPG.

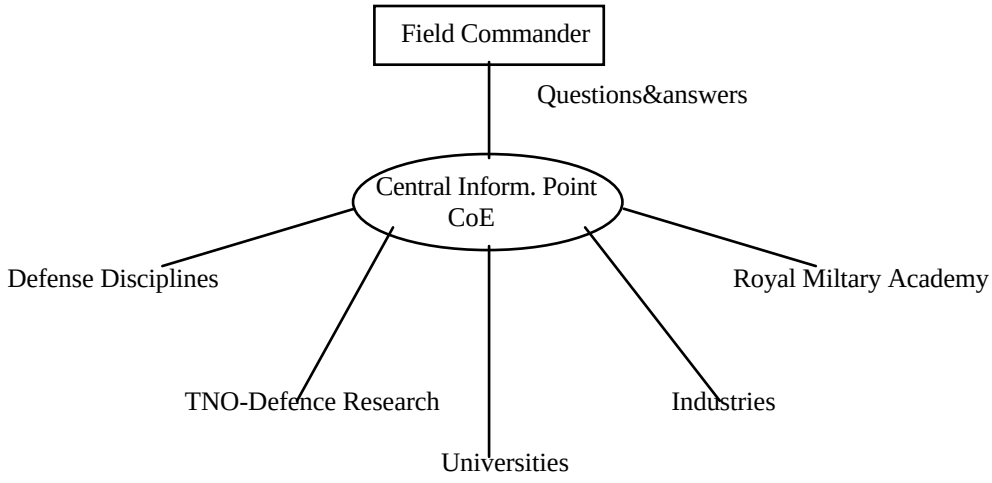

Figure 1 Schematic organisation scheme of Central Information Point of the CoE.

Collaboration and Standardization

In the Out of Area operations collaboration between various nations is essential. Merging different armies with each their specific character, background and equipment is complex and requires a strong and good organization. The mutual dependency of the participating nations on one hand and the responsibility for safety and task of their own personnel on the other hand makes international collaboration an utterly complicated matter. Standardization of directives, methods, materials and equipment will increase the flexibility in the collaboration.

Therefore, one of the key-words of the CoE for successful collaboration is standardization. International accepted guidelines, methods to realize e.g. protective structures or safe munition storage sides are needed. The necessity is realized, for example there are guidelines for munition storage based on safety and also security. But it are guidelines and no strict rules. The field commander is in charge and decides for his (small) unit or compound. And he

decides based on what he knows, needs, available equipment and time. The consequence is that no standardized storage side exists. But what about safety? Are the guidelines good enough to help the commander to make the right decisions?

Referring to this example, the UN-guidelines for munition storage in Out of Area, seems to be composed from various rules and experiences. The result is a set of inconsistent advises which in real life might lead to very unsafe situations. For the Dutch MOD this was not acceptable. Therefore, the MOD has initiated a working programme to inventory the current situation and guidelines and to make a draft guideline for the storage of munition and explosives in Out of Area missions (see ref.[1]).

This example illustrates the difficulties that rise for operating in a new situation. In short term existing knowledge must be gathered, combined and released. Time for cross checks is limited and applicability emerges from true life. The responsibility for the field commander is high. Therefore, he should be supported as much as possible. The Central Information Point of the CoE is an example of support.

For the TNO-PML, the support also means evaluating and improving fortifications. This involves the concepts, the applied materials and quantifying the protection level. Although the circumstances force the military engineer to apply very old and basic concepts, and very often inventive solutions are needed, the results and developments in technique, new materials and science must be incorporated. In the next paragraph these aspects will be elaborated.

3 Support on Fortifications

To support the Dutch military engineer for his task in Out of Area operations a standard, “Handbook Protective Structures”, was compiled. In this handbook the basic techniques for protection against explosion effects as blast, fragments, heat radiation and small caliber projectiles are listed. Geometry’s, lay-outs and their consequences for vulnerability are mentioned. Guidelines are given to determine the dimensions of walls and roofs for several types of structures. From this standard, field regulations for fortifications and semi-permanent shelters will be derived in the near future.

Because of his position and his task the military engineer must be acquainted with the basics of structural protection. Teaching the old principles must form an important part in the training course. Protection against fragments and small projectiles is realized by strong, hard material or mass. The mass must be supported by a bearing structure. Besides the static loading the structure must resist the blast and impact loading. Wood for the bearing structure and soil or sandbags for stopping the fragments, are still the most applied materials.

Sandbags, big bags and also the Hesco Bastions are forms of containing loose material (varying from sand to gravel or broken concrete) and add indirectly “tensile strength” to the material. Commonly the walls are constructed with sandbags and Hesco Bastions. Geotextile, and also loose threads can be applied to reinforce the soil and improve the properties of the material. Sandbags and reinforced soil are used in the protective roof structure. Of course layered systems with gravel or rock rubble are applied to improve impact

resistance. Various concepts are indicated in the “handbook” and special attention is paid to the water outlet because water containment ruins the properties of the protective soil structure. An overview of possibilities and research on geotextiles at the Dutch Royal Military Academy is given in ref 2. Currently there is no research programme running in the Netherlands on the improvement of soil containment or soil reinforcement.

Thinking about applying old principles, new techniques and standardization the Hesco Bastion wall is a good example. The need for reducing the construction time, logistic requirements resulted in the commercially produced Hesco Bastion Defense Wall System. The features of this product are good, alternatives are scarce, so the Hesco Bastion protective wall has become almost a standard. Extensive testing programmes were performed to quantify the protection level of these type of walls and constructions. (see ref .3 and 4).

The concept that is often applied is given schematically in Figure 2. This concept was also tested as reported in Ref 3 and 4. In this concept an ISO-container is applied, with the advantages of standard dimensions, multiple use, improving conditioning storage and comfort. The standard sizes container is combined with the standard Hesco Bastions as wall structure. The protective roof structure is conventional i.e. wood and sandbags.

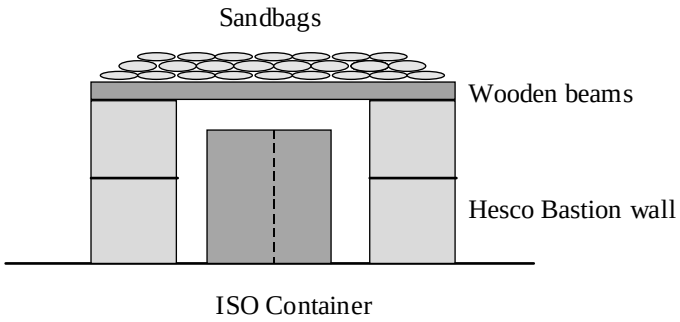

Figure 2 Example of protective structue.

The Dutch CoE is looking for alternatives especially for the protective roof structure. In collaboration with the TNO-PML a supporting programme was defined to find and test alternatives for the roof constructed with sand bags. As mentioned before, the layered system is an option but also incorporating hardened “flat racks” in the roof structure will be considered. Discussions about the threat and protection level are going on. Hitherto, the MOD and TNO-PML decided to consider the direct hit of a 81 mm mortar and the 155 mm shell at three meter distance as the threat.

The basic idea behind the collaboration is combining the practical experience and need of the military engineer with the applied scientific expertise of TNO-PML. Quantifying the explosion effects and the response of the structure and the consequences for personnel, equipment and ammunition is one of the tasks of TNO-PML in this programme. The result must be an improved concept for the protective roof structure, but also a set of “quality demands” to the products that are applied. The latter aspect was not mentioned so far, but because of the urge to find solutions available products at the commercial market are “slightly modified” by the

manufacturer and sold with good promises. In our opinion defining the specifications of products needs attention.

4 New Developments

Although the principles of structural protection do not change, current developments and results of science and technique can give new perspectives and possibilities to find alternative solutions. Following these developments and establishing the possible importance for the CoE is also a task of TNO-PML.

An example, directly related to the Out of Area operations is mine clearing. Considering the problems involved in breaching, and moreover clearing of minefields, and especially the aspect of mine detection, reliability and speed have to be improved considerably. With the features of nowadays electronics, data acquisition and powerful computational techniques considerable progress must be possible. Recently the Dutch MOD started a large programme on the humanitarian demining aspects of detection and clearing. The TNO Defense Research Laboratories are directly involved.

Also on protection computational techniques and the developments in for example new, composite materials offer new possibilities. In order to examine the possibilities of light weight structural materials and finding alternatives for the sand bags as protection against horizontal threat as small caliber projectiles and fragments, a research programme is running at TNO-PML. Selected manufacturers were invited to submit their products for blast and ballistic tests. Worthwhile to mention is the need for light weight blast- and fire resistant wall systems in the offshore industry. The threat level is different but the mutual interest in light, protective systems must be explored. The same counts for the developments in naval ship design, alternatives for steel are considered. In the experimental part of this programme, the submitted panels are tested on blast resistance in our 2-meter shock tube and sequentially tested on the ballistic resistance in the ballistic lab, see ref. 5 and 6. In the second half of this year we will start with high explosive blast tests on the light weight panels.

For the design of an optimum product or system, the combination of experiments and numerical simulation must be explored. The advanced computer codes offer possibilities to understand the physics and the failure process better, parameter studies are relatively easy, but they have their limits. Therefore, the combination with experiments is essential. Examples of work are given in ref.7.

5 Concluding remarks.

The tasks of the military engineer in Out of Area operations differ considerably from his tasks in the former situation in which he operated in a static and well known and prepared infrastructure. This new situation leads to new demands for personnel and material. It is evidently that the CoE needs support, he needs to be well trained in the old skills of mechanics and civil engineering, but he also need with good material and equipment. He must be well supported a pioneer.

In the paper an impression was given of some of the problems that the CoE is encountered with and some examples of supporting programmes. Because the effectiveness of the peace-keeping and peace-enforcing operations strongly depends on international collaboration the standardization of guidelines, methods and equipment are necessary.

6 References

1 Dongen Van,Ph.
"Developments of directives for safe storage of amunition and explosives for military operations Out of Area".
TNO-PML report PML 1996-A33, Rijswijk, 1966.

2. Verhagen, A.H.
Some aspects of geotextiles and geomembranes in Military Engineering
Corps of Engineering Journal, No. 7., 1994.

3. DRA report
Bosnian Bunker Trial.

4. MWF report
Shelter Validation Trials

5. Dirkse, M.W.L and Doormaal van, J.C.A.M.
"Investigation into the dynamic and ballistic strength of two types of light weight panels".
PML report, PML 1996-A41, Rijswijk, 1996

6. Doormaal van. J.C.A.M.
"Literature study into light weight material for structural protection".
TNO-PML report (in Dutch), PML 1995-A77, Rijswijk, 1995.

7. Weerheijm, J. and Veen van der, B.
"Advanced tools for the design of protective structures".
Proceedings of The Future Battlefield, United Kingdom, 1992.